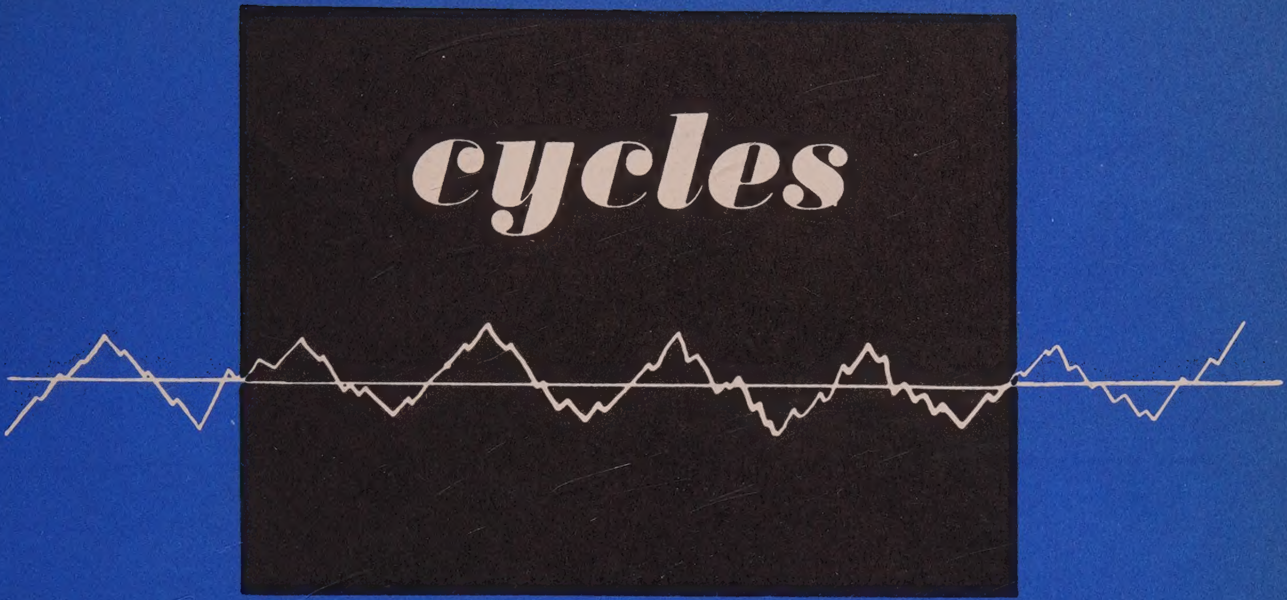
cycles



May 1956

FOUNDATION FOR THE STUDY OF CYCLES
New York, New York

CONTENTS

Page
DIRECTOR'S LETTER 127

RESEARCH
Observations on the 6-Year Cycle by Charles H. Pinkham 129
Frontiers of Science, by John J. Grebe 135
The 1956 Postscript to *Cycles--The Science of Prediction*
The 9-Year Cycle Continued 141

THE MODIFIED GEISINGER INDICATOR OF INDUSTRIAL PRODUCTION 150

THE FOUNDATION FOR THE STUDY OF CYCLES

The Foundation is a not-for-profit corporation, the board of directors of which consists of the following committee:

UNITED STATES OF AMERICA

Copley Amory, Chairman Emeritus

Charles Greeley Abbot
Research Associate
Smithsonian Institution

Harold Elmer Anthony
Chairman and Curator
Department of Mammals
American Museum of Natural History

George Baekeland, Chairman of the
Committee of the Foundation
The Bakelite Corporation

Harold Gardiner Bowen
Vice, Admiral, U.S. Navy, Retired
Executive Director, Thomas Alva
Edison Foundation

Verne Burnett
Partner
Verne Burnett Associate

Hon. W. Cameron Forbes
Member, Board of Trustees
Carnegie Institution of Washington;
Life Member of the Corporation,
Massachusetts Institute of Technology

Webster N. Jones
Vice President
Carnegie Institute of Technology

Daniel Trembly MacDougal
Former Director
Department of Botanical Research and
Laboratory of Plant Physiology
Carnegie Institution of Washington

John Quincy Stewart
Professor of Astronomical Physics
Princeton University

CANADA

Hon. Charles Camsell
Former Commissioner
Northwest Territories

Frank Cyril James
Principal and Vice-Chancellor
McGill University

GREAT BRITAIN

Sir Patrick Ashley Cooper
Governor
Hudson's Bay Company

Julian Sorell Huxley
Former Director General
United Nations Educational, Scientific and Cultural Organizations

Edward R. Dewey, Director

Cycles IS PUBLISHED BY THE FOUNDATION FOR THE STUDY OF CYCLES MONTHLY AT THE FOUNDATION'S OFFICE AT EAST BRADY, PENNSYLVANIA. SUBSCRIPTION RATE $10.00 A YEAR. ENTERED AS SECOND CLASS MATTER AT THE POST OFFICE AT EAST BRADY, PENNSYLVANIA, WITH ADDITIONAL ENTRY AT ANN ARBOR, MICHIGAN. PUBLICATION OFFICE, 680 WEST END AVENUE, NEW YORK 25, NEW YORK. COPYRIGHT 1956, FOUNDATION FOR THE STUDY OF CYCLES.

cycles

The official Bulletin of the Foundation for the Study of Cycles

VOLUME VII NUMBER 5 MAY 1956

The Director's Letter

Dear Member:

An important article in this issue is a talk about cycles given by Dr. John J. Grebe. Dr. Grebe is Director of the Nuclear and Basic Research Department of the Dow Chemical Company. The talk was given to a group of high school students gathered at Cleveland, Ohio, last May for the National Science Fair. The chart Dr. Grebe refers to is also printed. It is worth some study.

To quote from Dr. Grebe's talk, "As the explanation on the chart itself indicates, everything in nature has motion of a rhythmic, cyclical sort. The history of our scientific knowledge—of our understanding of the things about us—is a story of our increasing awareness and understanding of these cycles."

Dr. Grebe's appreciation of the vastness of the subject of cycles reminds me of a proposal by Dr. F. R. Moulton, at the time (1940) Secretary of the American Association for the Advancement of Science. Dr. Moulton suggested to me that "cycles" should be the theme for one of the annual meetings of the society.

At the time I thought a symposium of this sort would be premature. I asked Dr. Moulton to wait a few years. I am sorry now that I did.

The 6-Year Cycle

It is also a pleasure to print for you an article by Charles H. Pinkham, called "Observations on the 6-Year Cycle."

In the letter transmitting his article Mr. Pinkham said, "You will see that in the last paragraph of my article I try to get other Foundation members to go to work on this same subject. There must be some members...particularly those who have taken your course...who would have both the interest and the ability to make some constructive contribution on the timing or causes of the 6-year cycle."

I am hopeful that Mr. Pinkham's suggestion will bear fruit - but I see no need for limiting contributions to the 6-year cycle. Why can't we have articles about *any* of the cycles which have been reported upon from time to time, in *Cycles* or elsewhere?

Research

I have not yet used a penny of the money you contributed during the last year and a half for research. You can't rent an office and hire research workers without some hope of continuity. You can't have hope of continuity without a backlog of cash. Now that we have such a backlog, we can begin.

Because it has proved impossible to get competent help at East Brady, Pennsylvania, where I have my home, we are going to carry on the research work at Pittsburgh. Pittsburgh is about 60 miles southwest from East Brady. I shall drive back and forth as needed. If Mohammed won't come to the mountain, the mountain will have to move to Mohammed!

Revision of My Stock Market Projection of 1944 Coming Up

One of the first projects that will receive my attention will be a revision of my stock market projection of 1944. With 12 more years of figures to go on and 12 more years of experience in cycle analysis I hope to be able to do a substantially better job.

I shall also be glad to work on figures supplied by you if they are suitable for analysis and are of general interest. Let me know what you have available.

The results of all work will be published in *Cycles* and/or in the *Journal of Cycle Research*.

A Cyclopaedia of Cycles

If I can find a suitable person to do the work I plan to use a small part of the research money you have provided to start a Cyclopaedia of Cycles. This book would list in one place all cycles so far discovered by anybody. It would give for each discovery the phenomenon in which the cycle had been observed; the length of the cycle; the strength of the cycle; the time of the cycle; the place of the cycle; and the reference to the book or journal in which the information was published.

If and when this project can get going I'll publish the Cyclopaedia serially in *Cycles*.

This is a project which has been close to my heart for fifteen years.

Keep Smiling - Have Faith

At a home where I was entertained recently I found the following drawing on my pillow:

Isn't it a pretty good likeness of you too?

Cordially yours,

Ned Dewey

Edward R. Dewey
Director

Research

OBSERVATIONS ON THE 6 YEAR CYCLE

by Charles H. Pinkham
Executive V.P. and General Manager
Chambers and Wiswell, Inc.

RECENTLY we reviewed the various articles on the 6-year cycle which have appeared in this publication. All of them were prepared by Mr. Dewey and indicated that he had found the 6-year cycle in 32 different time series. It occurred to us that this wealth of material might contain hints of what causes the 6-year rhythm and that an analysis of the material might give us something more specific regarding the timing of the cycle.

Our first undertaking was to list the 32 time series in which Mr. Dewey had found the 6-year cycle...to indicate the peak year and the trough year of the idealized cycle in each case...and to show the source of this information in terms of date of issue and page number of *Cycles*. (Where there was more than one article on a particular time series, we listed the more recent one.) Our list follows on next page.

In his December 1950 Director's Letter Mr. Dewey stated:

"The research in regard to the 6-year cycle is important for several reasons. First of all, knowledge of a wave which accounts for so large a percentage of the fluctuations of so many economic time series is indispensable if we are to make adequate forecasts in regard to the future behavior of the industries involved.

"More than this, however, the presence of a 6-year wave in both natural and social phenomena gives us reason to suppose that human beings surge forward or retrench in response to heretofore unsuspected environmental forces.

"The fact that disturbances on the sun also respond to forces of seemingly the same time span suggests the possibility that the ultimate cause of these behaviors may lie outside the earth.

"More intensive work is needed to identify this 6-year rhythm over long periods of time, both on earth and in the sun, and to find out whether or not the wave lengths in the various series are identical."

Although we have not been in a position to determine whether or not the "wave lengths in the various series are identi-

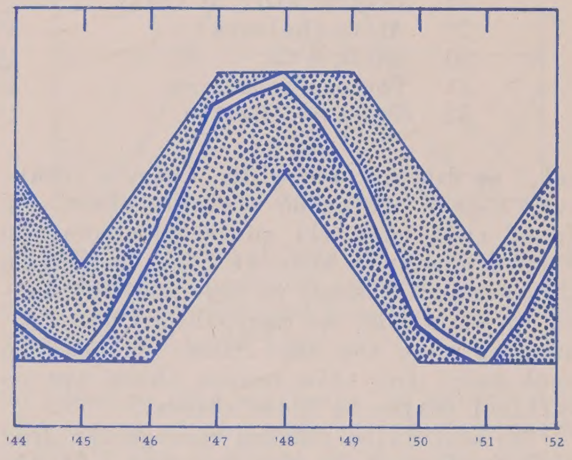


Fig. 1. Each of the 32 idealized 6-year cycles would all fall within this gray area. The white line running through the gray area is the synthesis of all 32 idealized cycles. (As amplitude is not of interest to us in this study, we have omitted the vertical scale from all charts...made all cycles the same height.)

No.	Time Series	Trough Year	Peak Year	Source: *Cycles* Date of Issue	Page
1	Stock Market	1944	1947	Dec. '50	5
2	Barometric Pressure	1944	1947	Dec. '50	6
3	Cotton Prices	1944	1947	Dec. '50	7
4	Rayon Production	1944	1947	Dec. '50	7
5	Inland Steel	1944	1947	Dec. '50	9
6	Youngstown Steel & Tube	1944	1947	Dec. '52	350
7	American Viscose Corp.	1944	1947	Jan. '53	24
8	DuPont	1944	1947	Jan. '53	25
9	Monsanto	1944	1947	Jan. '53	26
10	Jones & Laughlin Steel	1944	1948	Dec. '52	344
11	Sunspots (Double)	1944	1948	Dec. '50	6
12	General Electric	1944.5	1948	Dec. '52	340
13	Republic Steel	1944.5	1948	Dec. '50	12
14	Pittsburgh Plate Glass	1945	1947	Oct. '52	283
15	Montgomery Ward	1945	1947	Jan. '53	27
16	Bethlehem Steel	1945	1947	Sept.'53	218
17	Sears, Roebuck	1945	1948	Dec. '52	346
18	National Lead	1945	1948	Jan. '53	27
19	Armco Steel	1945	1948	Apr. '53	115
20	Continental Oil	1945	1948	June-July '53	171
21	Wilson & Co.	1945	1948	June-July '53	192
22	Goodyear Tire & Rubber	1945	1948	Jan. '54	10
23	Armour & Co.	1945	1948.5	Oct. '52	282
24	Goodrich	1945	1949	Dec. '50	15
25	Seaboard Air Line	1945	1949	Dec. '50	16
26	U.S. Rubber Co.	1945	1949	Dec. '50	17
27	Tree Rings (Inv.)	1945.5	1947.5	Dec. '50	6
28	Standard Oil of Calif.	1945.5	1948	Apr. '53	115
29	Allis-Chalmers	1945.5	1948.5	Dec. '52	342
30	Swift & Co.	1945.5	1948.5	Dec. '52	352
31	Cotton Production	1946	1949	Jan. '53	13
32	Proctor & Gamble	1946	1949	Nov. '53	307

cal," we did plot all of Mr. Dewey's idealized 6-year cycles on a single chart. We found that they all could be contained within the gray area of Fig. 1. (As in this particular study we were not interested in amplitude, we manipulated the figures to make the amplitude the same in each case. For this reason there are no vertical scales on these charts.)

The white line running through the gray area in Fig. 1 is the synthesis of all 32 idealized 6-year cycles.

In December 1950, Mr. Dewey commented:

"About a third of the industrial companies show ideal crests in 1948, but another third show ideal crests in 1947, and a final third have ideal crests in 1949."

Our 1956 analysis reveals the following percentages:

34% of the troughs are in 1944
47% of the troughs are in 1945
19% of the troughs are in 1946
38% of the peaks are in 1947
37% of the peaks are in 1948
25% of the peaks are in 1949

The most encouraging fact regarding timing is that in not one of the 32 time series does a peak fall in 1944, 1945, or 1946 nor does a trough fall in 1947, 1948, or 1949! This means that we will have some idea of where to look for the troughs and peaks of a 6-year cycle in any time series which we might wish to analyze in the future.

So much for timing. Now, what can these figures tell us about cause and effect? Mr. Dewey suggested that "the ultimate cause of these behaviors may lie outside the earth." The only time series, out of his 32, that "lies outside the earth" is the 6-year cycle in sunspots (double).

Let us assume that the 6-year cycle in sunspots causes the 6-year cycle in barometric pressure...which, in turn, causes the 6-year cycle in tree rings and in the 29 economic time series. Certainly a quick, easy solution to our problem. One look at Fig. 2, however, convinces us that we are on the wrong track. The peak of the barometric pressure cycle *precedes* the peak of the sunspot cycle by about a year. Inasmuch as it does not sound reasonable that barometric pressure on earth could influence sunspot timing, we must assume that if the 6-year cycle in sunspots and the 6-year cycle in barometric pressure are related, they are both caused by a common cosmic force.

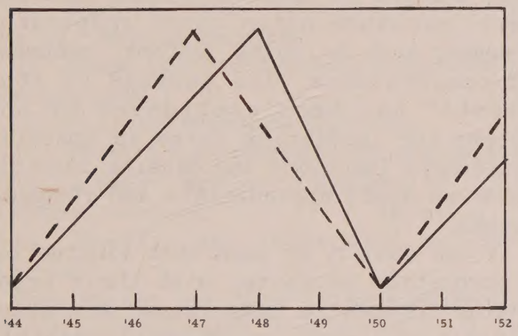


Fig. 2. Timing of idealized 6-year cycle in barometric pressure (broken line) and in sunspots (solid line).

It would be most gratifying if we could point to the 6-year, the 11-year and the 22-year cycles in sunspots and prove that they caused terrestrial cycles of like length. This has been tried many times by many researchers without success. The timing of solar and terrestrial rhythms is such that one would assume that they were both brought about by a common motivating force. Too often a sunspot cycle *follows* cycles of the same length in our terrestrial economy.

Would it be possible for the barometric pressure cycle to cause the tree ring cycle? Fig. 3 suggests that such a possibility should not be ignored. The barometric pressure cycles precedes the tree ring cycle by about 6 months at their peaks and by about 18 months at their troughs.

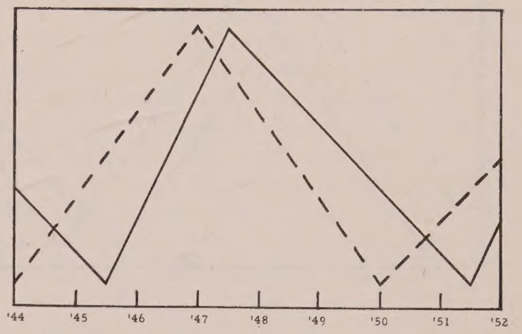


Fig. 3. Timing of idealized 6-year cycle in barometric pressure (broken line) and in tree rings inverted (solid line).

As a matter of fact, the barometric pressure cycle precedes the synthesis of the tree ring cycle and the cycles in all 29 of the economic time series (Fig. 4).

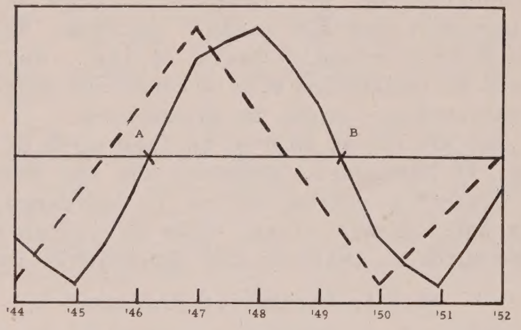


Fig. 4. Timing of idealized 6-year cycle in barometric pressure (broken line) and synthesis of idealized 6-year cycle in 30 time series (solid line).

To idealize this synthesis, we established the timing of the peak by taking a point one-half the distance between the upward and downward crossing (A and B). In Fig. 5 we can see that there is a lag of about a year between the 6-year idealized cycle in barometric pressure and the 6-year idealized cycle representing the synthesis of the 30 time series.

Although the 6-year cycle in barometric pressure precedes the synthesis of the 6-

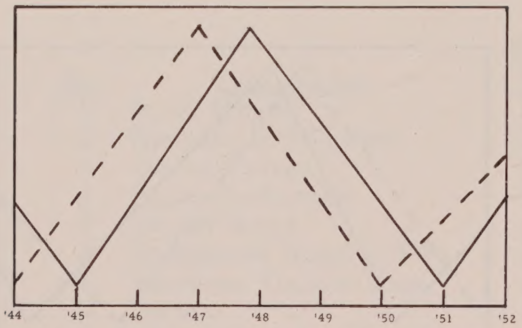


Fig. 5. Timing of idealized 6-year cycle in barometric pressure (broken line) and timing of idealized 6-year cycle developed from the synthesis of the 6-year cycle found in 30 time series (solid line).

year cycles in the 30 terrestrial series, there are 8 of these series which have cycles with the same timing as the barometric pressure cycle. (See time series listing: 1 to 9.) Of course, this does not rule out barometric pressure as a causal force...though it is presumably only a secondary one. Mr. Dewey's figures were apparently for six months' periods. Were these on a monthly basis, a lag...which could be reconciled with a cause and effect relationship...might be discovered.

But should we expect to find much of a lag? If barometric pressure has the power to distort economic series by influencing man and his decisions, this may often be done quickly...without *any* appreciable lag.

What Is Barometric Pressure?

What is barometric pressure? It is the amount of pressure of the air mass in which we live as measured by a barometer. At sea level, air pressure is about 14.7 pounds per square inch...about one ton per square foot. Mr. Dewey's barometric pressure figures were taken in New York and recorded as inches of mercury. 29.91 inches of mercury, for example, equals 14.7 pounds pressure per square inch.(1) His vertical scale goes from 29.71 down to 29.67.

The most disconcerting thing about barometric pressure is that its overall pattern varies from place to place. In the upper latitudes of the northern hemisphere it seems to be in correlation with the 11-year sunspot cycle. As we move southward this pattern disappears but re-appears *in reverse* as we approach the equator.(2,3) Obviously, a record of barometric pressure at New York is totally inadequate for any convincing comparison between the 6-year cycle in barometric pressure and the 6-year cycle in industry.

Sudden Drops Exert Profound Effects

However, perhaps a comparison between the 6-year cycle in barometric pressure... *taken in various places throughout the United States*...and this same cycle in nation-wide economic series might be enlightening. Before such a study is undertaken, however, it might be well to find out what is known about the influence of barometric pressure upon human beings.

Sudden drops in barometric pressure, as evidenced by storminess or turbulence of the atmosphere, "exert profound effects on human health and bodily functions."(4) Sharp changes in temperature and in atmospheric pressure often cause respiratory illnesses such as colds, asthma, pneumonia and tuberculosis. The passage of storm "fronts" has been considered by some writers the initiating force in upsetting physiologic functions and causing such illnesses as acute appendicitis and rheumatic attacks.(5,6)

It can readily be seen that fluctuations in barometric pressure, with their accompanying changes in temperature and atmospheric turbulence, might well upset the physiologic functions of the body and cause various types of illnesses. What is more important in our study, however, is the influence of barometric pressure upon man's aggressiveness, energy, drive, courage.

The Energizing Influence of Storms

Mills(4) compares favorably the progressiveness of the residents of eastern Texas with that of the people residing in the rest of the Gulf region. He also states that "the major development of the North Atlantic coast westward across the Ohio Valley and Great Lakes area to the Plains has not been by chance.'' His explanation as to *why* these two areas are unusually progressive is that they are subjected to the energizing influence of storms. And fluctuations in barometric pressure go hand-in-hand with storminess and atmospheric turbulence.

In our every day living we have all noticed that people are sad and depressed before a storm...when the barometer is falling...but that they are gay and full of vim and vigor after the storm has passed and the barometer has started to rise again. Following is a list of both animal and human reactions to falling barometer pressure.(7)

When barometric pressure is falling...

1. Farm animals become restless and irritable.
2. Cows become unruly, erratic.
3. Horses disobey orders, are inclined to bolt.
4. Hogs fight among themselves.
5. Dogs become restless, wander off.
6. Fishing is good.
7. People become tired, irritable, frustrated.
8. Children are naughty.
9. People toss in their sleep, are wakeful, have nightmares.
10. Headaches and fainting spells become more frequent.
11. Suicide attempts increase.
12. There is an increase in childbirths.
13. People are more forgetful; their attention wanders.
14. Traffic and industrial accidents increase.

Thus we can see that falling barometric pressure is accompanied by quite a long list of abnormal actions by man and beast. Perhaps we can assume from this list that when barometric pressure is below normal man is tired, forgetful, irritable and has difficulty in concentrating on business problems. Perhaps we can further assume that when barometric pressure is above normal man is more intelligent and more aggressive in business. If such assumptions were correct, then we could see why peaks in orders, sales, shipments or income in many large companies come at the same time or soon after peaks in barometric pressure.

But life is not that simple! We claim no more for our observed relationship between the 6-year cycle in barometric pressure and that same cycle in other time series than that barometric pressure *may* be one secondary factor out of many...one small piece, out of the hundreds in a jig saw puzzle, which contributes to the overall design.

The possibility that barometric pressure may be a clue to the identity of the causal forces which are responsible for the 6-year cycle in tree rings and in our economic time series should not be overlooked. Such a possibility is worthy of investigation.

There are other clues in Mr. Dewey's published material on the 6-year cycle that can be helpful to the researcher. For example, someone who is more of an economist than ourselves should examine the 2-year lag between the 6-year cycle in cotton prices and the 6-year cycle in cotton production and explain its significance.

The 6-year cycle is worthy of more attention than has thus far been given it. There must be some member of the Foundation for the Study of Cycles who can lead us one step nearer to the goal for which we are all searching...who can either confirm or point out the fallacies of our barometric pressure hypothesis...or who can give us another and better clue to the causal forces behind this rhythm.

BIBLIOGRAPHY

(1) Wenstrom, William Holmes, *Weather and the Ocean of Air*, Houghton Mifflin Company, Boston, 1942.

(2) Huntington, Ellsworth, *Mainsprings of Civilization*, John Wiley and Sons, Inc., New York, 1945.

(3) Clayton, H. H., "The 11-Year and 27-Day Solar Periods in Meteorology" *Smiths. Misc. Coll.*, Vol. 99, No. 6, 1940.

(4) Mills, Clarence A., *Medical Climatology*, Charles C. Thomas, Springfield, Ill., 1939.

(5) Petersen, William F., *The Patient and the Weather*, Edwards Brothers, Ann Arbor, 1934-7.

(6) B. de Rudder, *Grundriss einer Meteorobiologie des Menschen*, Julius Springer, Berlin, 1938, 2nd Edition.

(7) Mills, Clarence A., *Climate Makes the Man*, Harper & Brothers, New York, 1942.

Ridge House
Topsfield, Massachusetts

"Observations on the 6-Year Cycle" by Charles H. Pinkham

Work Sheet

Line series No.	1944	1944.5	1945	1945.5	1946	1946.5	1947	1947.5	1948	1948.5	1949	1949.5	1950	1950.5	1951	1951.5	1952	
1	0	140	280	420	560	700	840	700	560	420	280	140	0	140	280	420	560	
2	0	140	280	420	560	700	840	700	560	420	280	140	0	140	280	420	560	← [illegible]
3	0	140	280	420	560	700	840	700	560	420	280	140	0	140	280	420	560	" 3 " "
4	0	140	280	420	560	700	840	700	560	420	280	140	0	140	280	420	560	" 4 " "
5	0	140	280	420	560	700	840	700	560	420	280	140	0	140	280	420	560	" 5 " "
6	0	140	280	420	560	700	840	700	560	420	280	140	0	140	280	420	560	
7	0	140	280	420	560	700	840	700	560	420	280	140	0	140	280	420	560	
8	0	140	280	420	560	700	840	700	560	420	280	140	0	140	280	420	560	
9	0	140	280	420	560	700	840	700	560	420	280	140	0	140	280	420	560	
10	0	105	210	315	420	525	630	735	840	630	420	210	0	105	210	315	420	
11	0	105	210	315	420	525	630	735	840	630	420	210	0	105	210	315	420	← [illegible]
12	168	0	120	240	360	480	600	720	840	672	504	336	168	0	120	240	360	
13	168	0	120	240	360	480	600	720	840	672	504	336	168	0	120	240	360	
14	210	105	0	210	420	630	840	735	630	525	420	315	210	105	0	210	420	
15	210	105	0	210	420	630	840	735	630	525	420	315	210	105	0	210	420	
16	210	105	0	210	420	630	840	735	630	525	420	315	210	105	0	210	420	
17	280	140	0	140	280	420	560	700	840	700	560	420	280	140	0	140	280	
18	280	140	0	140	280	420	560	700	840	700	560	420	280	140	0	140	280	
19	280	140	0	140	280	420	560	700	840	700	560	420	280	140	0	140	280	
20	280	140	0	140	280	420	560	700	840	700	560	420	280	140	0	140	280	
21	280	140	0	140	280	420	560	700	840	700	560	420	280	140	0	140	280	
22	280	140	0	140	280	420	560	700	840	700	560	420	280	140	0	140	280	
23	336	168	0	120	240	360	480	600	720	840	672	504	336	168	0	120	240	
24	420	210	0	105	210	315	420	525	630	735	840	630	420	210	0	105	210	
25	420	210	0	105	210	315	420	525	630	735	840	630	420	210	0	105	210	
26	420	210	0	105	210	315	420	625	630	735	840	630	420	210	0	105	210	
27	315	210	105	0	210	420	630	840	735	630	525	420	315	210	105	0	210	← Fig. 3. Solid Line
28	360	240	120	0	168	336	504	672	840	720	600	480	360	240	120	0	168	
29	420	280	140	0	140	280	420	560	700	840	700	560	420	280	140	0	140	
30	420	280	140	0	140	280	420	560	700	840	700	560	420	280	140	0	140	
31	560	420	280	140	0	140	280	420	560	700	840	700	560	420	280	140	0	
32	560	420	280	140	0	140	280	420	560	700	840	700	560	420	280	140	0	
Total	6877	5273	4245	7075	11,068	15,621	20,174	21,262	22,035	19,634	16,385	11,631	6,877	5,273	4,245	7,075	11,068	
(-4245)	2632	1028	0	2830	6823	11,376	15,929	17,017	17,790	15,389	12,140	7,386	2,632	1,028	0	2,830	6,823	
(÷2118)	124	49	0	134	322	537	752	803	840	727	573	349	124	49	0	134	322	← Fig. 1. Synthesis of 32 time series.
Totals, less [illegible]	6877	5028	3755	6340	10,088	14,396	18,704	19,827	20,635	18,584	15,685	11,281	6,877	5,028	3755	6340	10,088	
(-3755)	3122	1273	0	2585	6,333	10,641	14,949	16,072	16,880	14,829	11,930	7,526	3,122	1,273	0	2585	6,333	
(÷201)	155	63	0	129	315	529	744	800	840	738	594	374	155	63	0	129	315	← Fig 4 Solid Line

FRONTIERS OF SCIENCE*

BY JOHN J. GREBE
Director, Nuclear and Basic Research Department
The Dow Chemical Company

WHEN I was first asked to speak before this group of young potential leaders in scientific thought and action, and their instructors, who no doubt, are providing much of the inspiration, my thoughts ranged back to the days when I was your age. How thankful I am for those who were concerned with us.

Any effort of mine that might help you enjoy and understand the frontiers of science and technology cannot be too much. I want some of it to spill over for my children and grandchildren and those of everyone else in the world.

A Science Fair Project

I, too, had a Science Fair project. Of course, it wasn't called that then. The great work of Science Service was instigated much later. But to me it was just as real a project as yours, and I worked at it for more than thirty years.

The inspiration came from two sources. First, from Mr. Pierce, that wonderfully interesting chemistry teacher at East Technical High School, here in Cleveland, who recently retired; and, second, from a poem printed in the daily paper, illustrated with a cheerful cherub plodding down an alley with board fences on both sides. It went like this.

"We must consider time like space,
As large and free and wide,
Not as if it were a road
With boards on either side."

And so today, I would like to launch you on a new kind of trip—a "Space Patrol" trip in which you will take your space along with you, just like you would have to carry your own atmosphere along in interplanetary travel. Our trip will carry us through time as well as space—a combination of H. G. Wells and Jules Verne—so our excursion can carry us to as many as infinity squared different places.

The new machine or instrument with which you will observe and drink-in the marvels of your surroundings, as you travel along the vista of time, time as large and free and wide as all space, is a new kind of visual aid chart. It is not any more complete than the periodic chart of the elements was in my day. This time, however, we have room on the reference frame of our chart of correlation not only for all the elements, their structure and their properties—as little as is known about them even now—but the whole of human understanding, with space to fill in more details in all directions. It plots all things along a scale according to the most common property—that of cycling, periodicity, frequency, wave length, equivalent energy per particle. Take your choice. All of these are directly inter-related mathematically through Plank's and Einstein's Laws.

Everything in Nature Cyclic

As the explanation on the chart itself indicates, everything in nature has motion of a rhythmic, cyclical sort. The history of our scientific knowledge—of our understanding of the things about us—is a story of our increasing awareness and understanding of these cycles.

In the process we have gone from the

---

*PRESENTED AT THE NATIONAL SCIENCE FAIR, CLEVELAND, OHIO, ON MAY 14, 1955.

study of phenomena observable through our unaided senses to the formulation of theories about the unobservable; thence to the development of tools which permitted us to observe the hitherto unobservable; thence to the development of further theories and so on.

Primitive man was able to observe the periodic rotation of the earth and the cyclical nature of the moon and the seasons although he did not understand exactly what was happening. Later, theorization, and the development of the telescope permitted us to study the celestial system and relate planetary movements to happenings on our own little globe.

From Known to Unknown

Likewise, primitive man was conscious of sound, and his ear, like ours, detected differences of pitch. But he did not understand the nature of sound. Only later did man, in his scientific search for truth, identify sound as a matter of vibration—of movement in regular cycles—with pitch related to the rapidity, or frequency, of the movement. With this knowledge one could then theorize that there must be similar vibrations inaudible to the human ear because they are either too rapid or too slow.

In fact, there are hundreds of octaves of vibrations outside the short range of our poor human ears. With instruments to aid us we have picked up some of these frequencies and thus pushed back a little way the frontiers of our knowledge of elastic and thermodynamic vibrations.

Similarly, from our curiosity into the nature of visible light we have vastly extended our knowledge, and thereby our use, of electromagnetic waves.

All of these, and other types of cyclical movements, are inter-related and are plotted on this chart. The outer circles represent the unbelievably high frequencies of cosmic rays and the particles waves within the nucleus of the atom. Because the scale is logarithmic the inner circles represent eons of time. So you are, in effect, looking into the horn of infinite time.

The outer area also indicates very high energy values, and as you travel toward the throat of this horn, it is the wave length or time that increases so enormously. Each digit represents a change by a factor of 10, so that between these two circles labeled *10* and *15* there is an increase in frequency or energy of 100,000 fold and a decrease of wave length down to 1/100,000th.

That is the only way we know how to shrink these near infinities in both radial and axial time directions down to a size, we can visualize and discuss.

Direct Observation

The dark blue area represents the observations that are possible through your own senses. This includes that small section of the electorn-magnetic wave spectrum that is our visible light, the sunlight range. There are small portions of the infrared spectrum to which you are sensitive through your sense of smell. Your sense of feel makes it possible for you to grasp the significance of the thermal radiation, the temperature of things around you. There is a small portion of the spectrum of elastic vibrations that is covered by the range of sound frequency heard by the ear. It increases your depth of perception wonderfully. You are sensitive to a small portion of the thermodynamic spectrum through your sense of taste. Not that you could measure the voltage of a hydrogen ion concentration cell in your mouth, but still I'm sure you can tell vinegar acid. And, of course, the combination of these senses of sight and feel makes it possible for you to observe and measure and comprehend much of the material that is around you, ranging in size from about 1/1000 of an inch on up. You can even tell the presence of a spider web by the reflected light.

You can observe oscillations due to gravitational forces, all the way from a short pendulum as it travels to and fro, to tides, winds, and the variations of the moon. The combination of the greatest tools, the written language and your senses, makes it possible for you to understand a fair amount about the growth and death of plants, insects, animals, and men. Your mind can traverse large areas of philosophy and meditation.

Your conscience can keep you alert to watch your motivations, that they always be pure and spring from love, rather than selfishness.

The Telescope and the Microscope

But, you can readily see that even a few hundred years ago, our senses are all we had to go by. It was the invention of the telescope by Galileo that made it possible for man to look back along a path of time and see the unfolding of much longer period motions — the cycling of our planets, moon, and stars. It gave Newton the information to analyze the whole of the theory of the gravitational spectrum. Then, with the wonderful development of the microscope by Leeuwenhoek, it was possible to stretch the observations into the spectrum of living cycles tremendously, so as to see the growth and reproduction cycles in cells and bacteria. None of you need to be told what a springboard for future developments this has been and certainly will continue to be.

The Electron Microscope

The electron microscope has carried us even farther, making it possible, for example, to study virus, as small as they are, and enzyme actions in a scale of dimensions that is millions times smaller than what could be observed with the naked eye. In the last 150 years, there has been a very rapid development of the tools for research that makes possible the more complete explanation of most of the studies in thermodynamics and the electromagnetic wave spectrum.

It is all these tools that take us over into the light blue area of the chart -- that area which we can observe today with the tools we have built to aid us. It is an area that is steadily expanding and, which some of you will help to expand further.

Other New Tools

Even now cosmotrons and betatrons are being built and operated that extend the frequency and reduce the wave length by a factor of one hundred million. We are far beyond the point of where Einstein's prediction of being able to convert matter into energy, and energy into matter, have been fulfilled. We are utilizing the binding energy in an atom, that nuclear glue that holds together the particles of matter, neutrons and protons, and the heat and radiation and mesons, by the splitting and fusion of atoms. And, conversely, we are taking billion volt energy and converting this into matter.

We are even generating with very new tools and accelerators ultra-high energy elemental particles. There is a completely new spectrum of mesons being charted, some of which were predicted mathematically by the Japanese Nobel Laureate Yukawa.

So, you see, this chart before you presents, in a crude outline form, the inter-relation between all observed phenomena.

The least known and of the highest frequency are the nutrinos, mesons and elemental particles now produced in the laboratory, though observed for a number of years as part of Cosmic Radiation. These mesons are matter now being produced in the laboratory from energy. Next come the matter waves. It is believed they are the basis of that property of matter which we know as mass and inertia. They include some of the constituents of cosmic rays and, of course, we generate them regularly at a frequency in cycles per second up to 10^{30}, i.e. 1000000000000000000000000000000, in mass spectrographs, electron microscopes, and electronic vacuum tubes of all kinds, as well as in cyclotrons.

Other Sorts of Cycles

The next kind of cycles deal with the binding forces of the nucleus of the atom — the kind of atomic energy the sun draws on for its enormous amount of radiation. There is relatively little known about this spectrum, but much work is being done on this now.

Next, we do know a lot about electromagnetics -- the radiations produced by the oscillation of charged masses -- because they were revealed so extensively in spectroscopic, television, radio, and ordinary electrical power research. Most of you have seen frequency correlation charts of these electromagnetic phenomena. They cover an extremely wide range -- from periods measured in days, and years, such as magnetic disturbances due to sun spots, on up to the high frequencies of gamma and cosmic rays.

The next distinctly different constituent of nature gives rise to the property of elasticity embraced by thermodynamics in its broad sense. It has to do with the interatomic forces involved in the compression and expansion of gases, liquids, and solids, in the ring of a steel bar, the peal of a bell, the vibration of a reed, the transmission of our sound waves. It has also to do with the heat energy relations in chemical reactions, such as the burning of fuels. The frequency responses dealing with this science range from 10^{20}. i.e. 100000000000000000000 down to periods measured in days, including the small range of audible sound in its most easily observed form.

Next, we deal with that elusive property of gravity — that which takes the mass and inertia property of matter and gives us weight. It, too, is evidenced in a wide range of frequency responses, from that of a very short pendulum to the changes which tides - planetary cyclic motions and interstellar attractions.

The next ingredient in Mother Nature is the phenomena of living forces which differentiate themselves from the dead, inanimate matter by growth and reproduction cycles. Their periods range all the way from the splitting of cells in about twenty minutes, to the life cycles of mammals and vegetation measured in terms of years.

The next attribute found in nature is mental activity. This development and growth covers still longer periods and it deals with much longer range problems. For example, the cycles of public attitudes on some subjects are measured in terms of many years.

Conscience

Finally, we deal with the highest constituent of creation -- the conscience. It hardly ever comes into play in connection with anything with a life cycle of less than a year. The welfare of a blade of grass you step on wouldn't become the subject matter of the activity of your conscience. It deals with the long range wellbeing of individuals, families, cities, nations, and in its best and most developed form, the welfare of all humanity.

Now -- the unique thing about these distinct and separate ingredients is that they share the property of cycling. Each of them seems to follow this same fundamental relation -- the frequency is a function of the restoring force divided by the inertia.

Everything Acts According to Law

The second important general observation is that all these natural forces seem to act according to the second law of thermodynamics. They tend to attain lower and lower frequencies, longer periods, and longer lives. High frequency energy can enter into the low, but low frequency quanta cannot revert to the higher except by the cooperation of a number of quanta contributing energy to the one. You can't turn a crank faster than your hands will go. Also, to convert any one kind of energy to that of the next longer period type, requires the cooperation of both.

As you know, no energy is ever destroyed. It is only diluted or converted to longer and longer periods, higher and higher entropies, to the point where we even measure the nobility of a person and his motives by the range of his point of view and actions. Each of the spectra show many examples recycle operations in which low potential energy is pooled to produce higher potential energy by various methods similated by a Vander Graff generator, windmill pump or electrical generator, lightening, the growth of mushrooms, gas engines and steam power plants.

And so the conversion of energy goes on from high frequency to low. Atomic energy (nuclear vibrations 10^{-20} sec/cycle) feeds the rays of the sun (electromagnetic waves 10^{-15} sec/cycle). The sun's rays energize the growth of grass (life cycles 10^{3} sec/cycle). The grass feeds the cow (life cycle 10^{8} sec/cycle). The cow lives and dies, providing for man (mental processes 10^{9} sec/cycle). Man nourishes his soul (conscience 10^{30}) and then dies to free it.

Thus you see all these different scales on the chart — these different phenomena — are inter-related, one acting upon the next. Why do I take so much time, and go to such pains, to bring this point home?

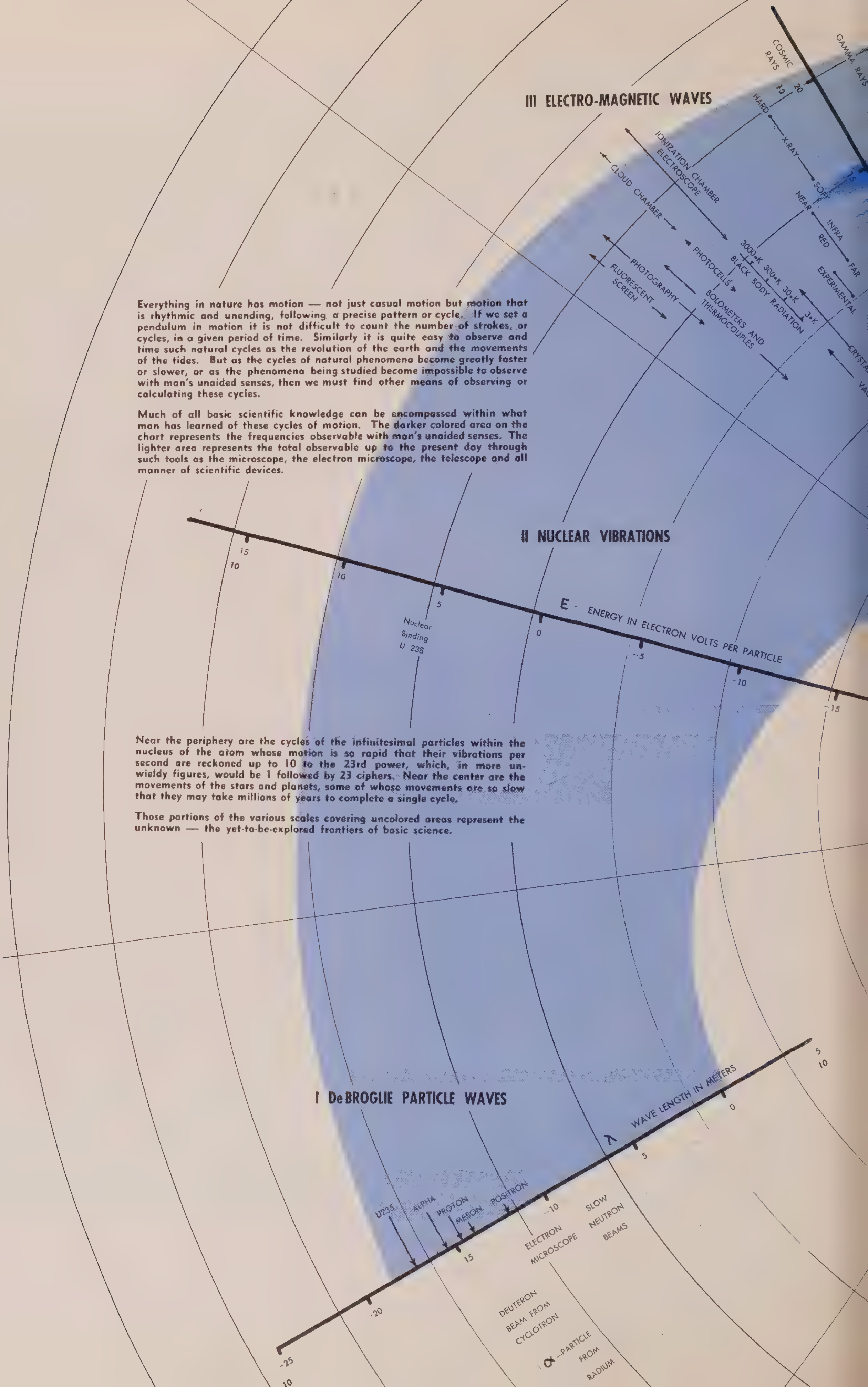
In the first place, because there are many areas on this little map which represent the unexplored frontiers of our knowledge. Some of you, I hope will help explore them. And, of course, even in the colored areas we need to know a great deal more than we do now.

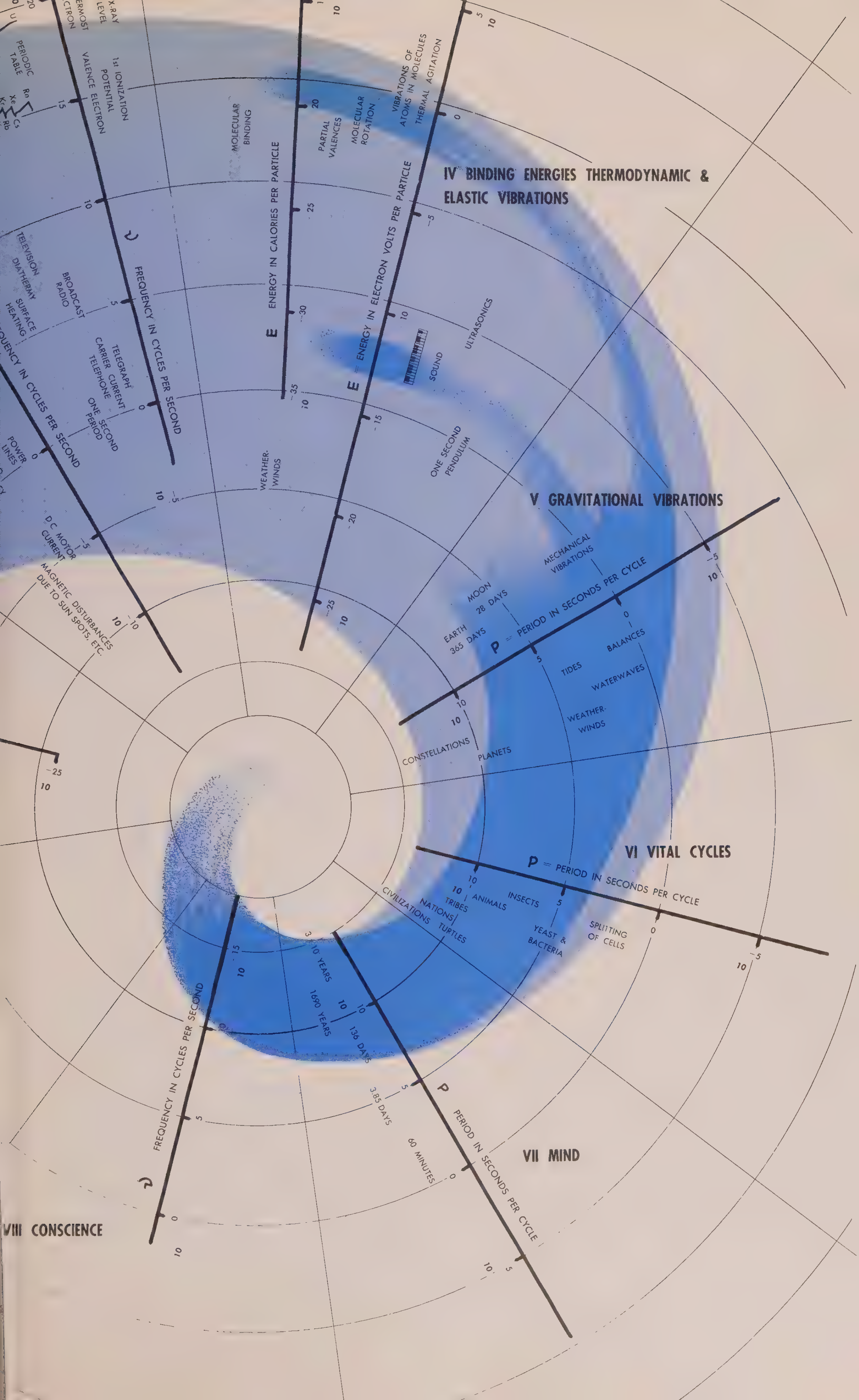
Everything in nature has motion — not just casual motion but motion that is rhythmic and unending, following a precise pattern or cycle. If we set a pendulum in motion it is not difficult to count the number of strokes, or cycles, in a given period of time. Similarly it is quite easy to observe and time such natural cycles as the revolution of the earth and the movements of the tides. But as the cycles of natural phenomena become greatly faster or slower, or as the phenomena being studied become impossible to observe with man's unaided senses, then we must find other means of observing or calculating these cycles.

Much of all basic scientific knowledge can be encompassed within what man has learned of these cycles of motion. The darker colored area on the chart represents the frequencies observable with man's unaided senses. The lighter area represents the total observable up to the present day through such tools as the microscope, the electron microscope, the telescope and all manner of scientific devices.

Near the periphery are the cycles of the infinitesimal particles within the nucleus of the atom whose motion is so rapid that their vibrations per second are reckoned up to 10 to the 23rd power, which, in more unwieldy figures, would be 1 followed by 23 ciphers. Near the center are the movements of the stars and planets, some of whose movements are so slow that they may take millions of years to complete a single cycle.

Those portions of the various scales covering uncolored areas represent the unknown — the yet-to-be-explored frontiers of basic science.




X-RAY LEVEL
VALENCE ELECTRON
1st IONIZATION POTENTIAL
PERIODIC TABLE
Rn
Xe
Cs
Rb
MOLECULAR BINDING
PARTIAL VALENCES
MOLECULAR ROTATION
VIBRATIONS OF ATOMS IN MOLECULES
THERMAL AGITATION
IV BINDING ENERGIES THERMODYNAMIC & ELASTIC VIBRATIONS
E = ENERGY IN CALORIES PER PARTICLE
E = ENERGY IN ELECTRON VOLTS PER PARTICLE
ν = FREQUENCY IN CYCLES PER SECOND
FREQUENCY IN CYCLES PER SECOND
TELEVISION
DIATHERMY
SURFACE HEATING
BROADCAST RADIO
TELEGRAPH CARRIER CURRENT TELEPHONE
ONE SECOND PERIOD
POWER LINES
D.C. MOTOR CURRENT
MAGNETIC DISTURBANCES DUE TO SUN SPOTS, ETC.
ULTRASONICS
SOUND
ONE SECOND PENDULUM
WEATHER-WINDS
V GRAVITATIONAL VIBRATIONS
MECHANICAL VIBRATIONS
MOON 28 DAYS
EARTH 365 DAYS
P = PERIOD IN SECONDS PER CYCLE
BALANCES
TIDES
WATERWAVES
WEATHER-WINDS
CONSTELLATIONS
PLANETS
VI VITAL CYCLES
P = PERIOD IN SECONDS PER CYCLE
ANIMALS
INSECTS
TRIBES
NATIONS
CIVILIZATIONS
TURTLES
YEAST & BACTERIA
SPLITTING OF CELLS
10 YEARS
1690 YEARS
136 DAYS
385 DAYS
60 MINUTES
P = PERIOD IN SECONDS PER CYCLE
VII MIND
ν = FREQUENCY IN CYCLES PER SECOND
VIII CONSCIENCE
20
15
10
5
0
−5
−10
−15
−20
−25
−30
−35

Now then, if you are to explore well you must carry with you this concept of the over-all vastness and interdependence of areas of natural phenomena and the sciences through which we study them.

Individually, you have worked on various projects and, no doubt, made up your minds as to various courses of study. This is all to the good. But just because you are going to study chemistry, or physics, or biology, do not bind up your mind in the enclosure of your particular science. This might all be well if you are only going to do routine work. But if you are going to be imaginative and creative then you must realize that there is really no enclosure there at all. The boundaries of the various sciences, if they exist at all, are thin and arbitrary.

I had thought at one time to try to plot the areas of the various so-called fields of study on the scales of this chart, but quickly gave it up. It would have been a cluttered mess, with departmental boundaries overlapping and superimposing all over the place.

All Inter-related

A hundred years ago we might have thought our science quite distinct and separate. Now that we can see so clearly the inter-relationship of all natural phenomena, we can see that our sciences simply have to be overlapping. A really new development in one, nudges its neighbor, leading to something there which, in turn, nudges the next and so on. Whenever we lose sight of this and throw up false barriers we are confining and restricting the limits of our imagination and our creativeness.

There is a great and exciting world of things waiting to be done by people with the power to project their thinking beyond the boundaries of the known and the conventional.

Infinite Energy

I suppose some thought we had reached the ultimate when we succeeded in splitting the atom, with its release of usable energy. Actually we are utilizing only a small portion of that binding energy which holds the particles of the nucleus together.

Far beyond this, we have recently observed the annihilation of a proton by an anti-proton with a resulting burst of energy hundreds of times that of atomic fission. These things make us realize what an infinite amount of energy man has available once he learns to use it. The atom, which we identify so simply on paper, is a virtual beehive of particles and forces which we really know very little.

We Have Been Only Creeping

Or consider the very large and complex molecules which we call polymers -- the man-made molecules which make up most of our plastics and other synthetic materials. Thrilling as have been our developments in this field, we have only been creeping. We are just now on the threshold of brand new methods of using our knowledge of constructing molecules to make the things all humanity needs to live better.

The forces of gravitation we know little about and we use them only in the crudest sense. We have not begun to find a way to multiply or divide them.

While the great 200" telescope peers into the distant past, 2000 millions of light years away, we are also developing the instruments to study and understand gravitational forces and energies mixed in with the electrostatic and the electromagnetic in matter under extreme pressure. And so you find, that a great experimenter, Bridgman, was given a Nobel prize in this old kind of physics, while other all around were working with much higher frequency and more intense energy relations.

That energy change, that mass change, which distinguishes living organisms from the same amount of inorganic material, is exceedingly small. I don't know whether it has ever been measured, but it is there, and it was the basis for that project of yours on the spontaneous formation of amino acids under possible primitive conditions. It is a modification, a forging, a changing, of the form of inanimate matter that gives it the capability of growth and reproduction. All these sort of things are being studied from the very highest frequency type, such as the formation of enzymes and amino acids, on down to the still more dilute and complicated energy changes involved in the reproduction of cells, spores, bacteria, insects, on through to the human beings.

What a wealth of information is being correlated. Now we are continually improving the life cycles of man on earth. Just think, in my day at high school, we youngsters faced more hazards and had a shorter life expectancy in normal, peaceful activities than the soldiers taking part in the great war just past. We should have been standing around at graduation, weeping and moaning about the dreadful life ahead.

Now, then, let us recapitulate. You may consider this presentation a fairy tale about throwing a child's lariat to interesting subjects, or treat it as a new kind of funnel to bring a better understanding of things to human beings. Or, you may say that all this is nothing but a periscope that gives you, not only the view ahead -- but also the whole periphery, all the frontiers of science. It is a sort of an exponential horn that helps you cover all frequencies at the same time. Some may consider it a presumptuous oversimplification.

Nevertheless, there is one simple chain of thought, on chain reactions for energy transformation that I would like to leave you. It's this. Neutrons -- matter waves -- elemental particles -- enter the nuclear glue, or binding mass. A portion of this binding energy is converted into heat, radiation, nutrinos and more neutrons that continue the chain. This is going on at enormous rates in stars, particularly our sun. It is also going on within the earth, which is after all a large atomic reactor. A very small portion of this overall energy ends up in the electro-magnetic spectrum as radiation, light, electrical power and the many forms of electrically operated devices. A smaller portion, much smaller, ends up as the chemical binding energies, and mechanical and elastic energy. A still smaller portion ends up as winds, rain, and other gravity controlled energy cycles.

These sources of energy feed into life cycles, living organisms, cycles of enzymes, and protoplasms. They feed the wealth of bacteria in the soil and water, upon which our plants draw for nourishment. Again a small fraction of this serves as food for insects, fish, and animals. The remainder recycles. Of these, again, a very small fraction serve the purpose of feeding human beings, with the largest portion merely recycling, to improve the lot of later generations of fish and animals. Man nourishes his soul, and then dies to free it.

Love The Culmination

When one can visualize and feel this progressive, ennobling of mere elemental particles, and their binding energy, through this long chain of energy transformations, one cannot help but sense that great Love that is the culmination of our human aspirations.

We cannot be thankful enough for the very human motivation of love for fellowmen that is reducing hazards and suffering on all fronts, in international problems as well as the daily activities of production and distribution, and for the tremendous progress in the cultivation of the mind. Just think of television, progressing from the incoherent, purposeless steps of "babes in the woods" to some of the finest, most thrilling and uplifting presentations of scientific facts and the longer range and deeper insight into human relations. It gives much fuller understanding of that greatest motivation of all, over which our conscience stands as guide and policeman, the love of God and man.

If you can say that you know what you are living for, the purpose of your work, what the aim and object of your life is, then you are rich indeed. You will continually have that intimate communion with infinite wisdom and a love that compares with this depth of perception through the vista of time. Your life will be rich beyond compare. Your heartaches and suffering will be that of the person who sees others blind themselves to the beauties of creation and the loveliness of people by looking at life from the narrow platform of their own reasoning and selfishness. They do not have that central force that ties together all of their observations, emotions and efforts into a beautiful unified whole.

Pray God that you each might ride on the crest of the waves presented by this whole range of spectra, grasping the unity and beauty of it all, taking part in the marvels of its future unfolding.

Thank you!

The Dow Chemical Company
Midland, Michigan

THE 1956 POSTSCRIPT

TO

CYCLES—THE SCIENCE OF PREDICTION

PART V: THE 9-YEAR CYCLE CONTINUED

"YOU were going to tell me more about the 9-year cycle," said my friend Robert Steele as we settled ourselves for our customary Sunday afternoon chat.

"Yes," I answered, "And I've been boning up for it, too. I've made a list of all the '9-year' cycles I could conveniently put my hands on. But of course it just scratches the surface."

"Why do you say that?"

"Because, as a '9-year' cycle is present in average wholesale prices, it is necessarily present in many—probably hundreds—of the various commodity prices that go to make up that average. Similarly, as it is present in stock market averages, it must be present in at least one or two hundred individual stock prices. And finally, there are thousands of series of figures where no one has ever looked to see if it's present or not."

"Gracious," said Robert. "How many series of figures do you have available for study?"

10,000 or 15,000 Series of Figures

"I suppose 10,000 or 15,000 would be a *very* conservative estimate. One book alone, *Historical Statistics of the United States 1789—1945,* presents 3,000 series of annual figures and refers to thousands more. The *Survey of Current Business* contains about 2,800 series of monthly figures. Add 1,000 more for commodities and individual stock prices not covered in either book and you get a sizeable collection for just one country and largely for just one subject—economics. Now add local figures. Then add in all the other countries. Then add disease and all the natural science figures—earthquakes, variable stars, weather, ocean currents, animal abundance, thickness and thinness of tree rings, thickness and thinness of rock strata, volcanic eruptions, sunspots, aurora, magnetic variations, and I know not what all. It's enough to choke a hippopotamus!"

"It is indeed!" said Robert. "How do you sleep o'nights?"

"Sometimes I don't." I answered.

Charts Not Up to Date

"Before we get into those other things," said Robert, "there is one thing I want to clear up. You explained it last week but I didn't understand it very well. Why weren't those charts you showed me last week up to date?"

"They were, as far as I could bring them. Take the stock market figures for instance. The chart showed percentages above or below a straight line trend smoothed by a 13-quarter-year moving average. To make the chart I used figures through the fourth quarter of 1955, but the smoothing process lost the last six quarters. That is, when you smooth the curve in this way, even using the figure for Dec. 31, 1955 you can't possibly get a *smoothed* value past the second quarter of 1954.

"With pig iron and copper it is even worse because there we couldn't use a straight line trend. We had to use a moving average trend. For both copper and pig iron I used December 1955 figures to get the fourth quarter year 1955 values. But the moving average trend lost twenty quarter years or five years in the process of computation. And so of course the last percentage above or below trend was five years behind too. Fourth quarter 1950 was the last figure of this particular series (percentages above or below a 41-quarter-year moving average trend) humanly possible to chart, and this is the figure shown.

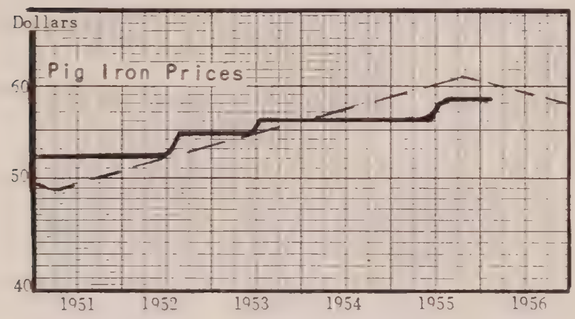
"For copper prices, I ventured to guess the trend up to date, but even here the smoothing process--a 17-quarter-year moving average cost us 8 quarter year or 2 years. This means that the fourth quarter of 1953 was the last figure humanly possible to show. Of course the values past 1950 are uncertain (because the trend was only a guess) and I showed them by a broken line to indicate this fact."

"Well, I see what you are up against," said Robert. "But don't you have charts of the *actual* figures, unsmoothed and without adjustment for trend?"

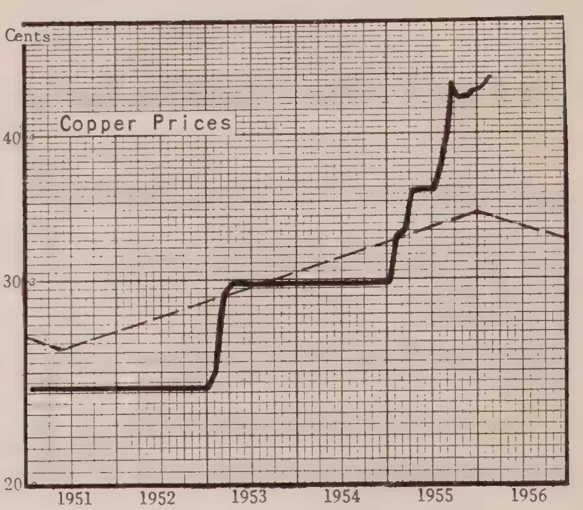
"Oh yes, we always have those," I answered. "Would you like to see them?"

"Yes." said Robert.

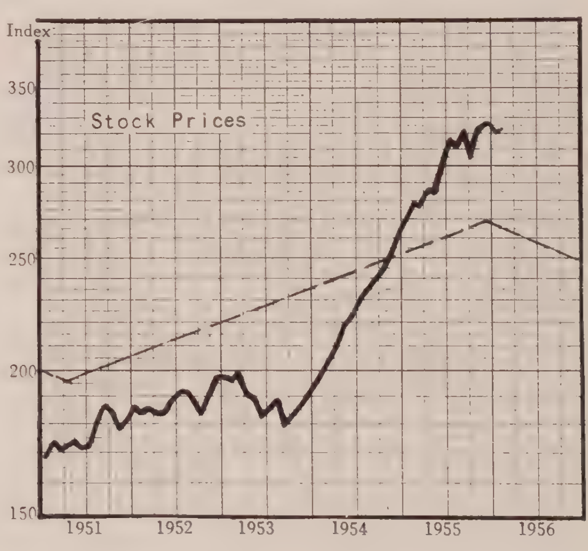
"Here they are for pig iron, for copper, and for the stock market, month by month, 1951 to date. I've also drawn in diagrams of the ideal 9-year cycles. [See below.]



PIG IRON PRICES AND THE '9-YEAR' CYCLE
January 1951--February 1956
Solid line: Wholesale prices of pig iron, composite index, in dollars per long ton.
Broken line: Diagram of the ideal 9.2-year cycle. (Ratio Scale.)



COPPER PRICES AND THE '9-YEAR' CYCLE
January 1951--February 1956
Solid line: Prices of electrolytic copper bars, New York, in cents per pound.
Broken line: Diagram of the ideal 9.28-year cycle. (Ratio Scale.)



STOCK PRICES AND THE '9-YEAR' CYCLE
January 1951--February 1956
Solid line: Standard & Poor's Corporation combined index, 480 stocks, 1935-39=100.
Broken line: Diagram of the ideal 9.15-year cycle. (Ratio Scale.)

"As a rule I hate to show charts of this sort as they mislead people. They seem to imply that the prices will, or at least should, go up or down from the month indicated. Of course this is not so at all. In any given instance the actual crest (or trough) may come a year or two or even more before or after ideal timing. Any one cycle is only one of *many* factors entering into the situation."

"Yes," said Robert, "*I* understand, but I can see how some people might get mixed up.

"Now that we've got that cleared\up," continued Robert, "let's get back to my earlier question. I want to know more about this 9-year cycle. A cycle which keeps on coming true for nearly 100 years after discovery is worth knowing something about."

Three "9-Year" Cycles

"As I said last week, there seem to be three cycles of this general length. One seems to be about 9 years long, one seems to be about 9 2/10 years long, one seems to be about 9 1/3 years long. Lengths such as 9.28 which we find in copper prices could arise from combination of 9 2/10 and 9 1/3 year cycles, or as I said last week, they could be the result of randoms.''

"Then why couldn't the 9 2/10 be a blend of 9.0 and 9 1/3? Or 9.0 be a blend of 9 2/10 and, let us say, 8 8/10?'

"It could," I answered. "We don't yet know for sure. For now all we can do is to take facts as we find them—that is, to catalog the manifest cycle—the cycle as we see it. When we do this we seem to get the three lengths I have listed."

"Why do you say *seem* all the time? Don't you *know,"*

"No. There are so many randoms and so many other cycles that, in series of figures as short as the ones we have been dealing with, we cannot be sure of the exact length."

"From 1784 to date isn't short."

"It is from the standpoint of a 9-year cycle. It's less than 20 repetitions. And anyway many of our series are only half as long."

"Could they all be one and the same cycle?" asked Robert.

"I don't think so," I answered. "The 9 2/10 and the 9 1/3 could perhaps be different measurements of the same thing, but I think the 9 is a separate cycle. However, I don't know for sure. The exact length and timing of all so-called '9-year' cycles should be redetermined."

"Where has it been found so far?" asked Robert.

"In quite a number of things," I answered. "Here are all I can think of at the moment:"

Abundance of lynx
Sunspots
Thickness and thinness of tree rings
Abundance of grasshoppers
Wholesale prices U.S.A., Germany, and England
Pig iron prices
Copper prices
Railroad stock prices
Industrial stock prices
Combined R.R., industrial, and utility stock prices
Wheat prices
Venereal disease
Manufacturing production
Liabilities of commercial and financial failures
Sales of a large manufacturing company
New members, Presbyterian church, Episcopal church, Methodist church, Congregational church.
Cattle on farms."

"I'm all mixed up again," said Robert. "Abundance of lynx! I thought you told me that the lynx cycle was 9.*6* years long."

"I did. The 9.6-year cycle is the dominant cycle. But there is a 9.0-year cycle there *too*."

"I don't understand," said Robert.

Lynx Have Two Cycles

"Lynx act as if they were influenced simultaneously by *two* cyclic forces. One force has a wave length of 9.6 years; the other force has a wave length of 9.0 years.

"That's very confusing."

"It doesn't confuse you when applied to the tides. The tides are the result of a lunar force *and* a solar force. What you see when you observe the tides is a combination of the two.''

"Yes, I know that," eaid Robert, "but it seems odd when applied to lynx. What are these forces?"

"No one knows," I answered. "But if our sky were perpetually overcast like the sky of Venus so that we couldn't see sun or moon no one would know the cause of the tides either—at least in the early days. Of course in time, as we learned about such things, we could deduce the necessary existence of the two causative heavenly bodies. That's what we are trying to do with cycles. We are trying to learn enough about them so that we can deduce their causes even if we can't see them."

Lengths Close Together

"What gets me is two wave lengths so close together."

"We find them much closer. A difference of 1% difference in wave length isn't unusual."

"With two different forces operating I should think the result would be all mixed up."

"No, it doesn't work that way. The 9.6-year force is so much stronger that it dominates. You can't even see the effect of the 9.0-year force until you adjust for the effect of the 9.6-year force.

"Are you *positive* that there are these two forces affecting lynx abundance?"

Simplest Explanation

"No, not positive. It doesn't pay to be too positive about anything. But when we have an effect we are entitled to postulate a cause. And the simplest explanation of the effect we observe is two causes, one with wave length 9.0 and one with wave length 9.6. Of course the effect *could* be the result of one force with wave length 9.6 and of *varying intensity*—a force that got weaker year by year for 72 years, then stronger year by year for 72 years. However, there are two arguments against this idea. First, in science, we always choose the simplest explanation. Second, we find a 9.0-year cycle by itself in other things --for example the number of new members joining the Protestant churches and the number of cattle on farms."

"You've made a pretty good case for two cycles in lynx abundance." said Robert. "But why only two? Why not three for four or five?"

"Oh, there are! Eight have been isolated and there are likely more. I mentioned only the 9.0 because I am trying to hold the subject to cycles 9.0 to 9.3 years long. By considering the cycles of these lengths all at the same time I hope to show you that in studying these cycles we are dealing with something really fundamental. I made a start at it last week by showing you that in pig iron prices and in copper prices a 9.2 or 9.3-year cycle had been *continuously* present since 1784—172 years and that in the stock market it had been *continuously* present since 1854--102 years. I showed you that it had continued to come true after discovery for nearly 100 years. Now I am showing you three more things: First, I'm showing you that these cycles are present in *many* different phenomena. Second, I'm showing you that they are present in *natural* and in *social* phenomena as well as in *economic* phenomena. And third, I am going to show you that, regardless of the nature of the phenomena, all these cycles have turning points at more or less the same time. Can you imagine all these coincidences, all this uniformity, all this corresponding pattern, occurring as a result of chance?"

"No." aaid Robert.

Bird-Brain from Boston

"And yet I just got a letter from some bird-brain in Boston resigning because he said he wasn't interested in insects! Hell's bells! I'm not interested in insects either! But when you find *cycles* in insect life with the same wave length as the *cycles* in economic life you know you are getting down to something really basic. You'd *expect* all economic figures to go up and down more or less together. But when you find the *same* cycle in something totally unrelated it can't be accidental. The very proof that he needs in order to have confidence in the reality of the economic cycle he blames me for giving him! He says I spread myself too thin. I admit it. Too *wide*, no! Too *thin*, yes! Too thin because, by resigning, he cuts me off from the money necessary to plow deeper! Oh well it takes all kinds!"

"I notice sunspots on your list." said Robert. "I thought you said at our last meeting that you'd never had time to investigate the nine-year cycle in sunspots."

"I did, but I was mistaken," I confessed. "A chap named Lane made a periodogram analysis of sunspots and found an important 9.3-year cycle. Using somewhat different and I think better methods I came up with a length of 9.15 years. This is *exactly* the length of the dominant cycle in the stock market, as nearly as I have been able to measure it. The 9.15-year cycle in the stock market crests ideally at year 1955.9; the ideal cycle in sunspots crests ideally at year 1956.0, a tenth of a year later—as nearly as I can measure it."

Stock Market Cycle Comes Ahead of Corresponding Sunspot Cycle

"Assuming your measurements are right, the 9.15-year sunspot cycle couldn't be the cause of the 9.15-year stock market cycle, could it." said Robert. "You can't have the effect *before* the cause."

"It isn't quite as simple as that," I retorted. "First of all we can't be positive about my measurements. They are the best I could do with annual figures in the time I had available. But with more time and by using monthly figures I could do a much better job. However, assuming they hold up, it still isn't proof. We may have to take latitude into account."

"How is that?"

Cycles Slip Latitudinally

"Well, as perhaps I told you, Dr. Wing has discovered that at least some cycles crest later and later as we find them from either pole toward the equator. This is true on the sun also. But sunspots are not uniformly distributed over the surface of the sun. They are mostly spread between 40° north solar latitude and 40° south solar latitude—say on the average 20° north and 20° south. The stock market however—being as it is all the people who buy and sell stock—would have an average latitude (in the United States) of about 40°. The 9.15-year cycle over the *whole* of the sun could come before the 9.15-year cycle over the *whole* of the earth, but come later at 20° north on the sun than at 40° north on the earth. Is that perfectly clear?"

"Yes," said Robert, "but do you *know* that the *9.15-year* cycle slides across the face of the sun from pole to equator?"

"No."

"Or that it slides across the face of the earth similarly?"

"No. That's why the study of cycles is such fun. There are all these things to find out!"

"Some people have peculiar ideas of fun," said Robert. "But anyway, regardless of which comes first, we do have evidence that a cycle found on earth is also found on the sun, don't we?"

"Oh very definitely."

"Are there other examples?"

"Many."

"But events on earth couldn't cause the cycles on the sun, could they?"

"No, not reasonably."

An Extra-Terrestrial Cause

"Therefore the sun *must* be the cause of the cycles on earth or, if not, the cause *must* be external to both the sun and the earth--something planetary or something cosmic?"

"Yes for those cycles found on both the sun and the earth."

"Well!" said Robert. "We *are* getting deep!"

"Yes," I said. "if you wish to be poetic instead of scientific, you could say that in studying cycles we're listening to God singing. And that pip-squeak in Boston...! But enough of him."

"Where is the work on sunspots published?" asked Robert.

"Lane's work is published in the *Journal of Cycle Research,* Vol. 3 No. 1 but my work has never been published."

"Why not?"

"No money."

"It seems dreadful to do important work like that and never let it see the light of day. Have you done anything else that isn't published?"

File Drawers of Unpublished Material

"Don't make me laugh." I said bitterly. "I've got *file drawers* full of unpublished material."

"Have you tried any of the large Foundations?"

"Yes, a number of years ago. It was a waste of time. There is plenty of money for mediocre hum-drum research—very little for trail blazing. In fact, an officer of one of the largest Foundations in the country used this very word *mediocre* to describe the kind of research his agency supported. Anything else might be subject to criticism! It always pays to play it safe!!!"

"Too bad," said Robert.

"Yes," I answered.

"I noticed that on your list manufacturing production also has this 9-year cycle." said Robert.

"Yes." I said. "In manufacturing production it measures 9.3-years long and the current crest is due ideally at 1955.65--as best I have been able to measure it. Here is a chart of it." See below.

"It isn't very regular, is it?" said Robert.

Not Very Strong

"No," I said. "It isn't very strong—it's kicked around by randoms and by other cycles. From trough to crest it moves only 11.5% of trend. That's an average fluctuation less than 2 1/2% a year. If I hadn't removed trend and some of the war distortion and an 11.2-year cycle and smoothed the result a bit you couldn't have seen it as well as this. Even so, it does repeat with a beat, time after time across the page. Starting with a low in 1870, three years late because of a post-civil-war distortion, we get, wave, wave, wave, wave, wave, wave, wave, wave, wave.

"I suppose the reason the curve ends in 1954 is because of the smoothing process." said Robert.

"Yes."

"And I suppose the curve is heavy from 1943 so we can see how it has unfolded since discovery?"

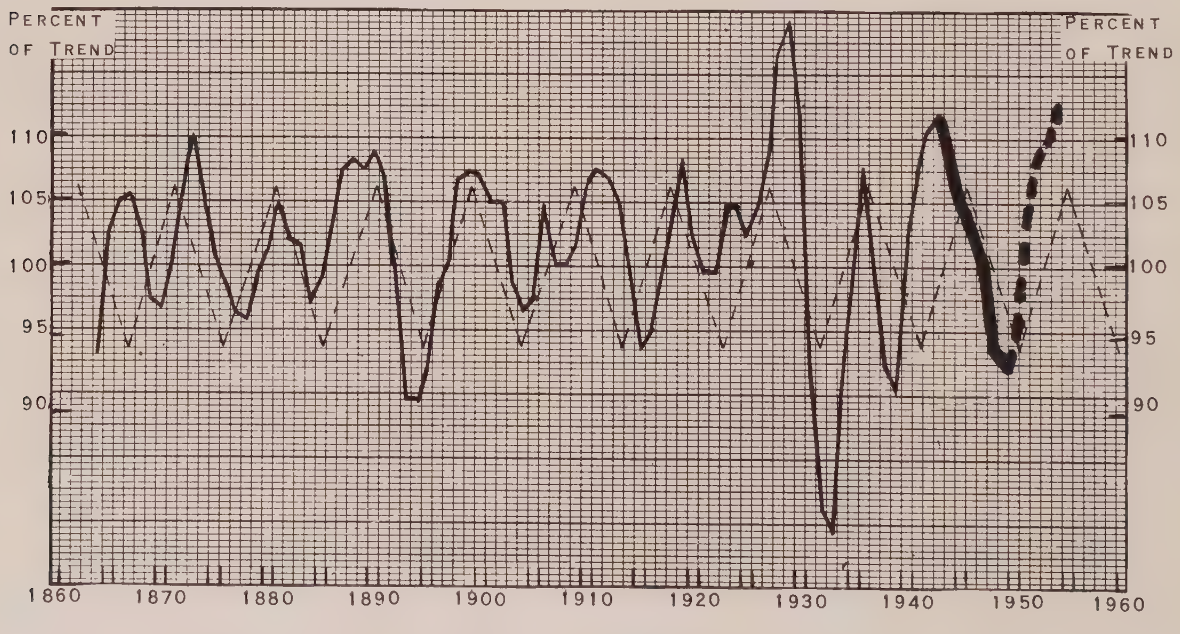
"Yes."

"And broken since 1951 because you had to estimate trend for these last few years?"

"Yes."

"I'm learning!"

"Indeed you are," I said. "Would you

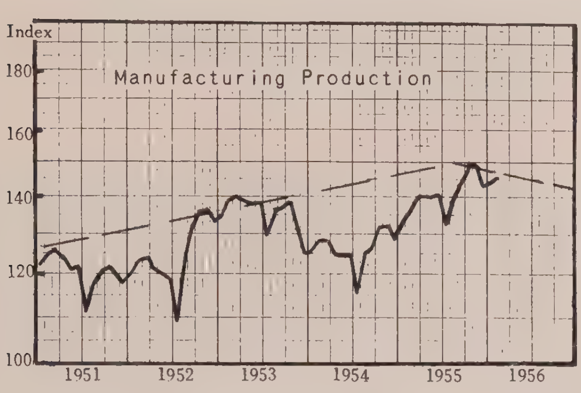


THE 9.3-YEAR CYCLE IN MANUFACTURING PRODUCTION
Solid line shows smoothed deviations from an 11-year moving average trend. Deviations adjusted for the 11.2-year cycle. Both deviations and trend adjusted for war. Heavy solid line shows how cycle has unfolded since discovery. (Values from 1951 forward are smoothed deviations from *estimated* trend.)
Broken line diagrams the timing of the ideal 9.3-year cycle. (Ratio Scale.)

like to see a chart of the actual figures of manufacturing production for the last few years?"

"Yes." he said.

"Here it is." [See chart below.]



MANUFACTURING PRODUCTION AND THE '9-YEAR' CYCLE
January 1951--February 1956
Solid line: F. R. B. Index of manufacturing production.
Broken line: Diagram of the ideal 9.3-year cycle. (Ratio Scale.)

"Does this mean that the physical volume of business will go down for the next 4 1/2 years?"

"Not at all. There are many other cycles and don't forget the randoms. But I do think it safe to say that manufacturing production, four and a half years from now, will be about 5% less than it would be if this 9.3-year cycle didn't exist."

"That isn't too satisfactory if you want an exact blue print of the future."

"No. Half a cup of lard isn't too satisfactory if you want a pie, either, but it's a necessary ingredient if you want a good one. It takes other ingredients if you want a good forecast *or* a good pie."

A Pinch of Salt

"Including a pinch of salt?" asked Robert mischeviously.

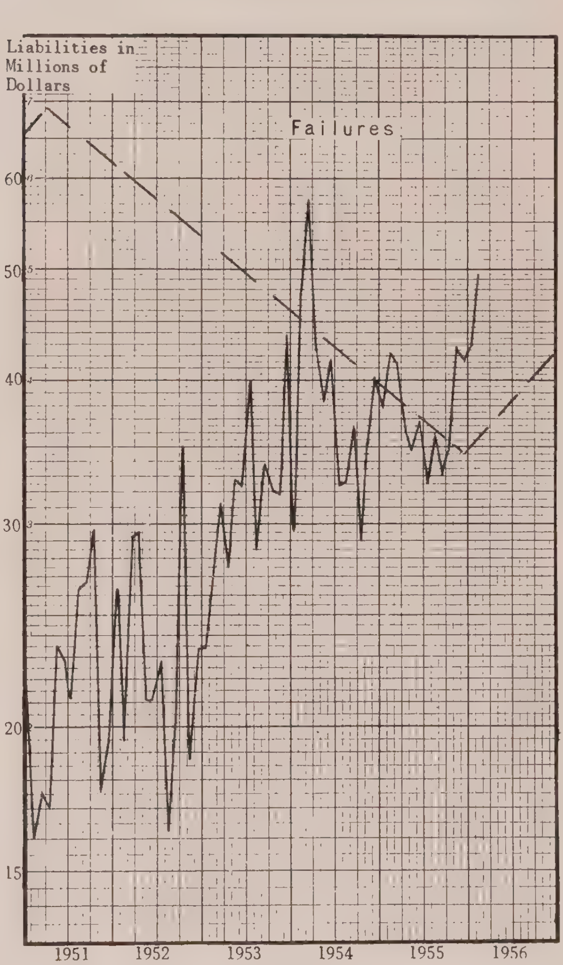
"Right!" I said, laughing.

"Another thing I remember on your list is business failures."

"Yes. The liabilities of commercial and industrial failures. This series is always more or less upside down from production. When we have lots of production we generally have few failures and vice versa. You'd expect the cycle to be pretty much upside down, and it is. It *troughs* in 1954.9, as nearly as I can measure it. This cycle in failures is therefore, ideally, going up at the present time. Would you like to see a chart of it?"

"Yes."

"Well, here it is. [See next two pages. And, in case you want to see it, here is a chart of the actual figures month by



FAILURES AND THE '9-YEAR' CYCLE
January 1951--February 1956
Solid line: Liabilities of commercial and industrial failures in millions of dollars.
Broken line: Diagram of the ideal 9.2-year cycle. (Ratio Scale.)

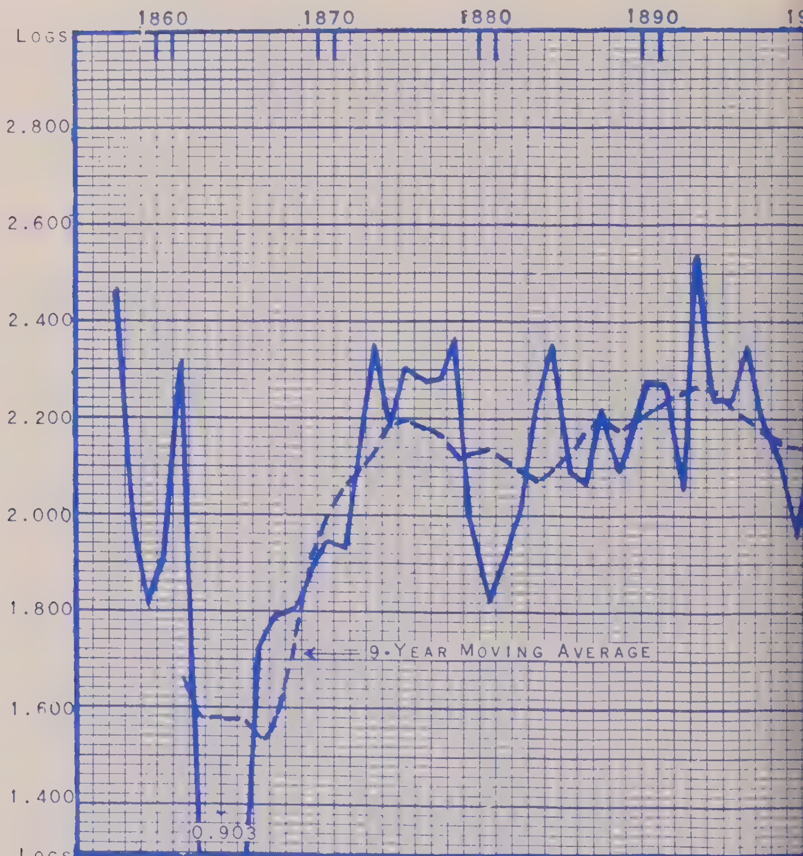
month from 1951 to date."

"It's not very good," said Robert.

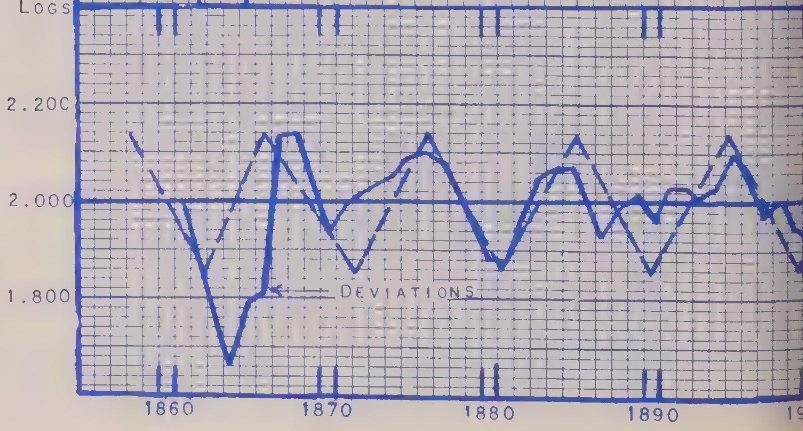
"Not in the actual figures, either monthly or annual," I said. "But if you look at the lower curve [below] where the smaller cycles have been smoothed out and trend eliminated you can see the cycle marching across the page with a good deal of regularity. Starting with a low in 1864 we see wave, wave, wave, wave, nothing, wave, wave, wave, wave, wave, right across the page. In the actual figures you have distortion due to war and to other cycles. The month by month figures were distorted up to about the beginning of 1954, but for the past two years they seem to be back on the track."

"Yes, it's plain enough in what you call

The 9.2-Year Cycle in Failures



Liabilities of Commercial and Industrial Failures and a 9-Year Moving Average Trend. (Ratio Scale.)



The 9.2-Year Cycle in Liabilities of Commercial and Industrial Failures. Deviations from Trend Smoothed by a 5-Year Moving Average, Together with an Ideal 9.2-Year Cycle. (Ratio Scale.)

the smoothed deviations. I suppose that expression means the amounts by which the smoothed figures deviate or go up and down from the trend."

"Yes."

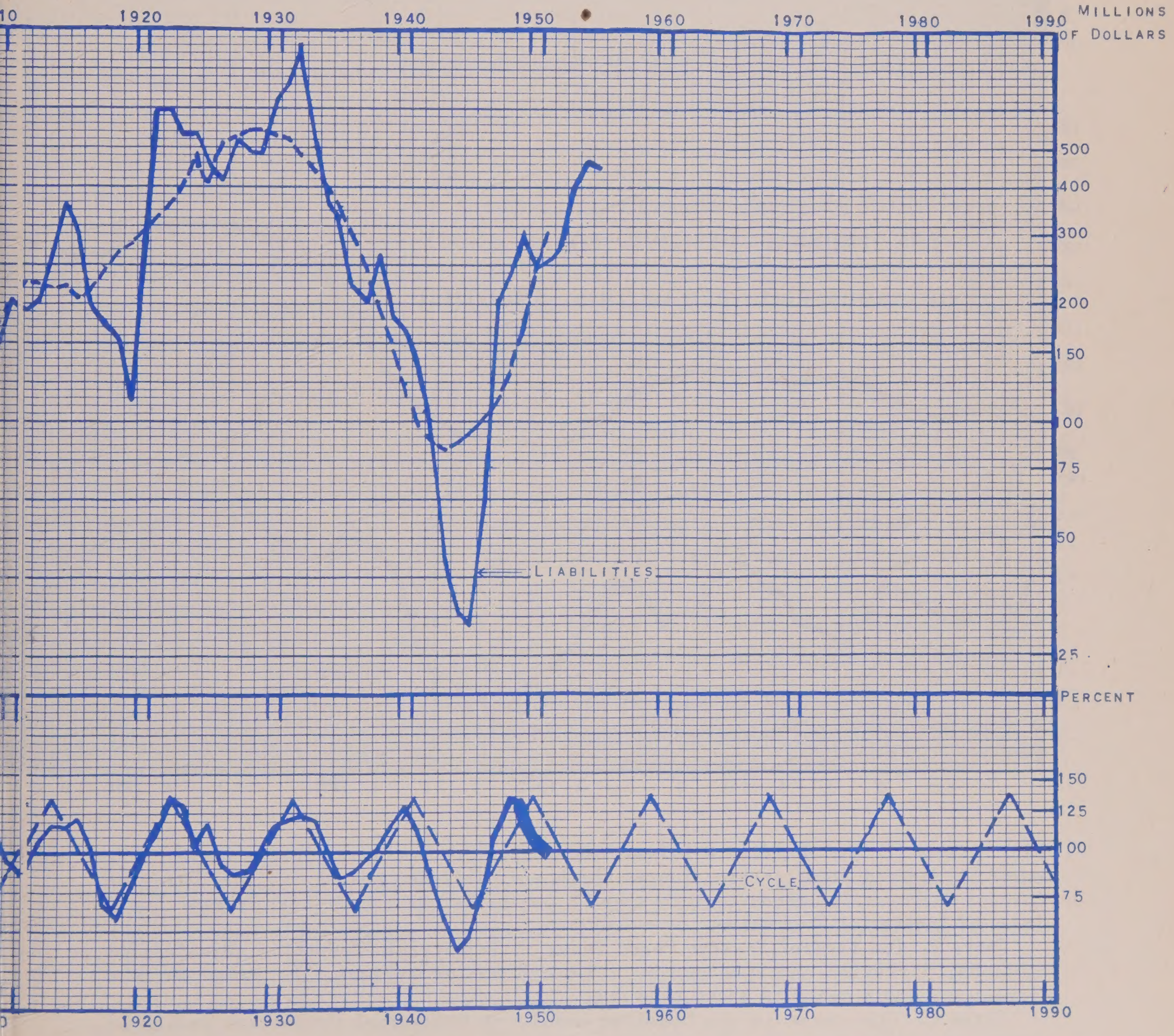
"It's very strong, too." I added. "This cycle in failures ideally is 38% above trend at time of crest, 31% below trend at time of trough. That's 69% of trend in 4.6 years or 15% change a year. Pretty terrific."

"What else do you have to show me about the '9-year' cycle?" asked Robert-

"Lots!" I said, "but what do you say we leave it for next time?"

"Well, maybe that's a good idea," said Robert. "Let's do that."

E.R.D.



THE MODIFIED GEISINGER INDICATOR

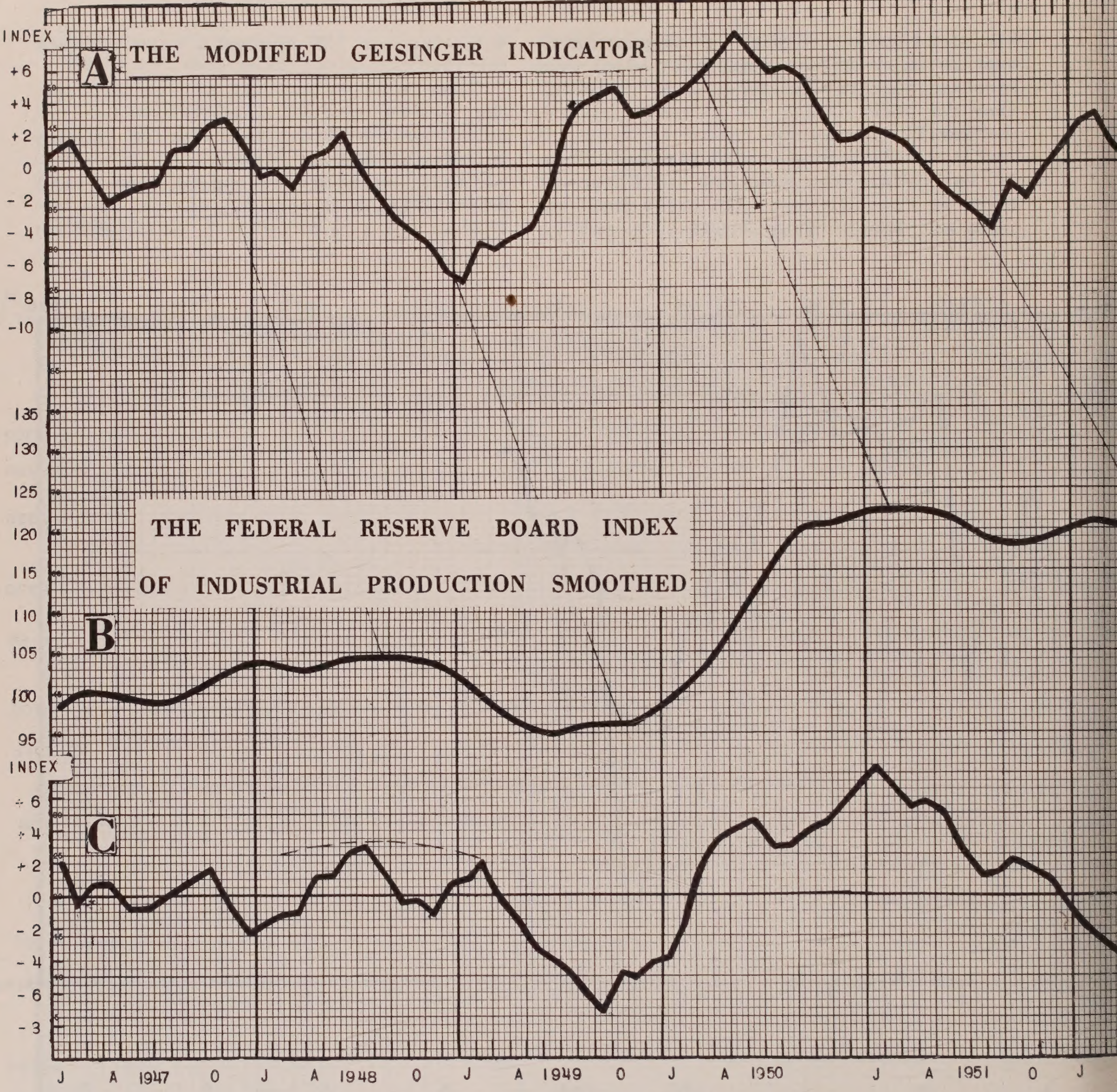
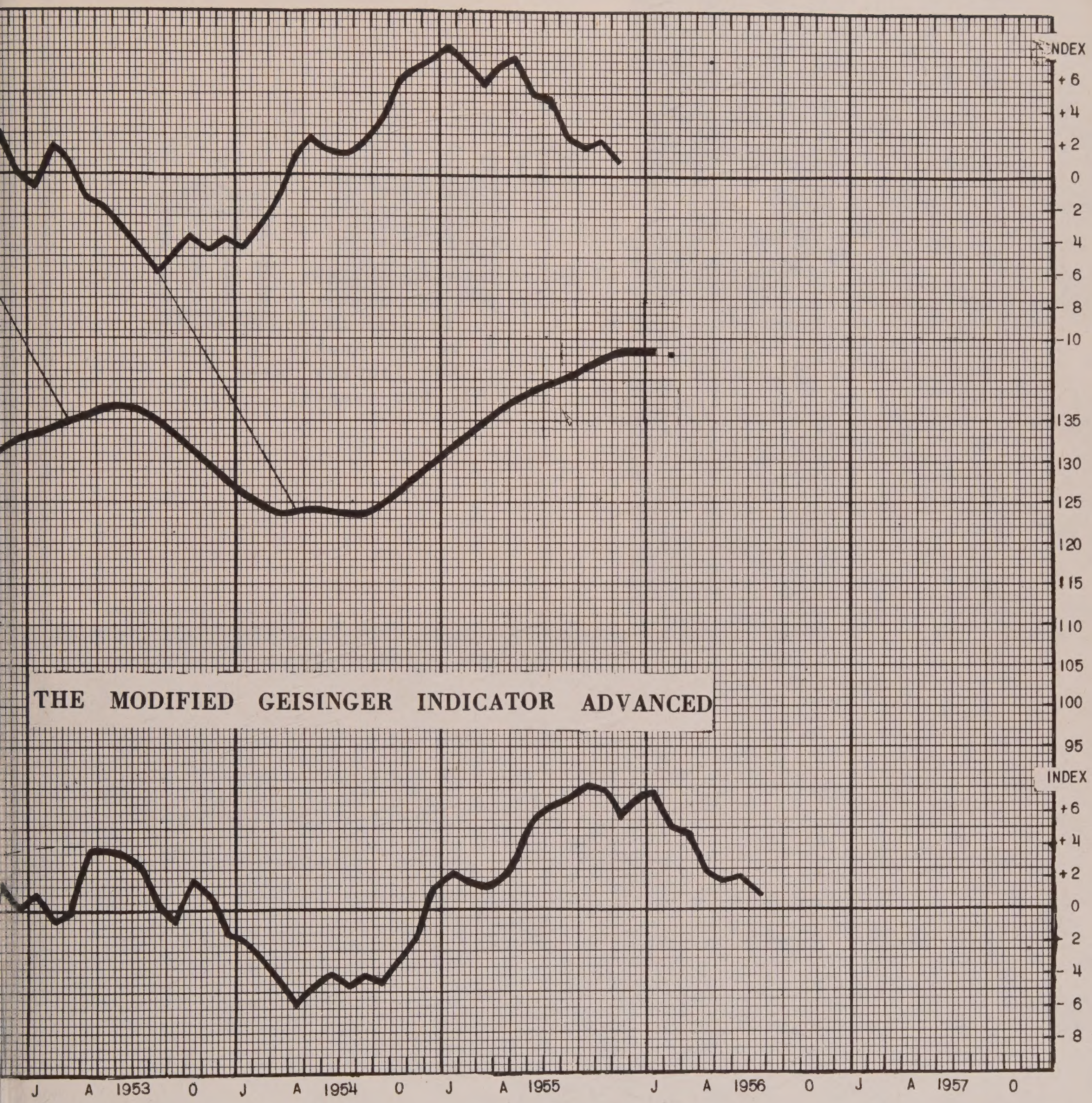


Fig. 1 Curve A. The Modified Geisinger Industrial Production Indicator Curve. This curve is derived from certain figures which are published monthly in the *Survey of Current Business*. It tends to turn about 8 months before the Federal Reserve Board Index of Industrial Production.

Curve B. The Federal Reserve Board Index of Industrial Production adjusted for seasonal variation and smoothed by a 3-month moving average. The value for the latest available month is shown by a dot.

Curve C. This curve is the Modified Geisinger Industrial Production Indicator Curve advanced by 8 months. This process projects part of the curve into the future. If the relationships of the past continue, the projection gives some hint of what may happen to the Federal Reserve Board Index of Industrial Production (Curve B).

OF INDUSTRIAL PRODUCTION



THE FORECAST

Due to a revision of one of its components, the Modified Geisinger Indicator for October 1955 (June 1956 when projected) goes down from +2.5 to +2.1.

The value of the indicator for November 1955 (July 1956 when projected) goes down to +0.8.

The F. R. B. Index itself has been practically stationary since October, the actual values being: October 143; November 143; December 144; January 143; February p. 143.

I see no reason to change my feeling that this is a time for caution, and that the F. R. B. Index of Industrial Production will go down during the coming year.

E.R.D.

Mr. H. A. Musham
741 No. Rush St.
Chicago, Ill.

FOR SALE

SETS OF BACK COPIES AT THE FOLLOWING PRICES:

1950 June, October, November and December $3.00
(All five issues, if we get them, $5.00)
1951 All ten issues. 5.50
1952 All ten issues. $5.50
(We will refund 50¢ if we are unable to supply the January issue.)
1953 All ten issues. 5.50
1954 All ten issues. 5.50
1955 All ten issues. 5.50

WANTED

BACK COPIES OF *CYCLES* AS FOLLOWS:

June 1950 September 1950 January 1952 May 1953 September 1953

BACK COPIES OF THE *JOURNAL OF CYCLE RESEARCH*

Vol. 1 No. 1 (Autumn 1951) Vol. 2 No. 1 (Winter 1952-53)

We will gladly pay $1 each for any of the above.

FOUNDATION FOR THE STUDY OF CYCLES
680 WEST END AVENUE
NEW YORK 25 NEW YORK